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Two new species and new records of Otocepheidae (Acari, Oribatida) from Yunnan, Southwest China

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Abstract

This work includes taxonomic data on four species of oribatid mites of the family Otocepheidae from Yunnan, China. Two new species of the genera *Basiceramerus* and *Eurostocepheus* are described, respectively. *Basiceramerus ovatus* **sp. nov.** differs from *B. bangladeshensis* Corpuz-Raros & Gruèzo, 2008 by the wavy marginalis passing the base of the adanal setae, prodorsal condyles well separated from median ones, a ventral ridge present, and the anal plate foveolate; it differs from *B. igorotus* Corpuz-Raros & Gruèzo, 2011 from Vietnam by the wavy marginalis passing the base of the adanal setae, a connected tutorium and lamelliform expansion, a ventral ridge present, a smooth genital plate, and seta an_2 located close to the median margin of the anal opening; it differs from *B. igorotus* from the Philippines by the lamellar setae inserted behind the tip of the lamella, separated prodorsal condyles, lyrifissure *im* posterior to *gla*, genital plate smooth, anal plate foveolate, and the wavy marginalis passing the base of the adanal setae. *Eurostocepheus* (*Eurostocepheus*) *sinutus* **sp. nov.** differs from other known species of this genus by having a ventral groove between the genital aperture and the ventral ridge, eight pairs of notogastral setae, and distinctly shorter and thinner notogastral setae p_1, p_2, p_3, h_3. *Eurostocepheus* (*Eurostocepheus*) *aquilinus* Aoki, 1965 and *E.* (*E.*) *mahunkai* Mondal & Kundu, 1999 are reported for the first time from China.

Keywords

Basiceramerus, China, *Eurostocepheus* (*Eurostocepheus*), oribatid mites, taxonomy

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Introduction

During identification of the oribatid mite material collected from Yunnan, Southwest China, we found four otocepheid species; among them two species are new to science belonging to the genera *Basiceramerus* and *Eurostocepheus*, and the others, *Eurostocepheus* (*Eurostocepheus*) *aquilinus* Aoki, 1965 and *E.* (*E.*) *mahunkai* Mondal & Kundu, 1999, are new records for China.

Basiceramerus was proposed by Corpuz-Raros with *Basiceramerus upelbensis* Corpuz-Raros, 1979 as the type species. Currently, the genus comprises six species, which are distributed in the subtropics of Asia: the Philippines, Bangladesh and Vietnam (Subías 2004, online version 2021). Before the present study, this genus had not been reported from China. The species herein described follows the generic characters (based on data from Corpuz-Raros 1979; Corpuz-Raros and Gruèzo 2008): fused median notogastral condyles present, apodemata II and apodemata *sj* long, 4 pairs genital, 1 pair aggenital, 2 pairs anal, 3 pairs adanal setae present, and leg setae *u* setiform (L-type) on tarsi I, thorn-like (S-type) on tarsi II–IV.

Eurostocepheus Aoki, 1965, which is distinguished from other genera of Otocepheidae mainly by its disproportionately dilated pedotectum II and conspicuously developed costula, comprises two subgenera: *Eurostocepheus* (*Eurostocepheus*) Aoki, 1965 and *Eurostocepheus* (*Cerostocepheus*) Mahunka, 1973. The main subgeneric difference lies in the number of genital setae, either 4 or 5 pairs respectively. Nine species of this genus, all from the Oriental region, were hitherto reported (Subías 2004, online version updated in 2021); among them only one species, *Eurostocepheus* (*E.*) *heterotrichus* Wen, 1999, has been recorded in China (Wen 1999; Chen, Liu and Wang 2010). A revised generic diagnosis and an identification key to known subgenera and species of this genus were given by Ermilov and Starý (2017).

In the following study, the two new species *Basiceramerus ovatus* sp. nov., *Eurostocepheus* (*Eurostocepheus*) *sinutus* sp. nov., are described and illustrated based on adults, and expanded descriptions and illustrations of *E.* (*E.*) *aquilinus* and *E.* (*E.*) *mahunkai* based in part on new information are provided.

Materials and methods

Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. Notogastral width refers to the maximum width in dorsal aspect. Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers. Formulae for leg setation are given in parentheses according to the sequence trochanter-femur-genu-tibia-tarsus (famulus included). Formulae for leg solenidia are given in square brackets according to the sequence genu-tibia-tarsus.

General terminology used in this paper follows that of Grandjean (1934), Ermilov and Starý (2017), Norton (1977), Norton and Behan-Pelletier (2009).

Abbreviations and notations

Prodorsum: *ro*, *le*, *in*, *bs*, *ex*–rostral, lamellar, interlamellar, bothridial and exobothridial setae, respectively; *cos*–costula; *tu*–tutorium; *spa.l*–lamelliform expansion; *tbd*, *tbv*–dorsal and ventral bothridial plate, respectively; *cpm*, *cpl*–medial and lateral prodorsal condyles, respectively.

Notogaster: *c*, *la*, *lm*, *lp*, *h*-row, *p*-row–notogastral setae; *cnm*, *cnl*–medial and lateral notogastral condyles, respectively; *vm*–vitta marginalis; *ia*, *im*, *ip*–anterior, middle, posterior lyrifissures, respectively; *ih*, *ips*–same, associated with setal rows *h* and *p*, respectively; *gla*–opisthonotal gland opening.

Coxisternum and lateral podosoma: *1a*, *1b*, *1c*, *2a*, *3a*, *3b*, *3c*, *4a*, *4b*, *4c*–setae of epimeres I–IV; *met*–mentotectum; *st*–sternal apodeme; *ap1*, *ap2*, *ap sj*–apodeme I, II, sejugal, respectively; *Pd I*, *Pd II*–pedotectum I, II respectively; *spd*–sub pedotectum; *fep*–epimeral foramen; *dis*–discidium; *opp*–postpodosomal ornamentation.

Anogenital region: *g*, *ag*, *an*, *ad*–genital, aggenital, anal and adanal setae, respectively; *vr*–ventral ridge; *iag*, *iad*–aggenital, adanal lyrifissure respectively.

Gnathosoma: *a*, *m*–anterior, middle seta of gena; *h*–hypostomal seta of mentum; *v*, *l*, *d*, *cm*, *acm*, *ul*, *su*, *vt*, *lt*, *sup*, *inf*–palp setae; ω–palp tarsal solenidion; *ep*–postpalpal seta; *cha*, *chb*–cheliceral setae; *cht*–tooth on dorsal chelicerae; *rbr*–rutellar brush; Tg–Trägårdh's organ.

Legs: σ, φ, ω–solenidia of genu, tibia and tarsus, respectively; ε–famulus of tarsus I; *d*, *l*, *v*–dorsal, lateral, ventral setae, respectively; *ev*, *bv*–basal trochanteral setae; *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv*–tarsal setae; Tr, Fe, Ge, Ti, Ta–trochanter, femur, genu, tibia, tarsus of legs, respectively.

Taxonomy

***Basiceramerus ovatus* sp. nov.**
http://zoobank.org/E8AFB948-9A53-47EF-9A1A-CFF080297747
Figures 1–5

Diagnosis. Body size (N = 4): 990–1360 × 540–650. Two pairs of prodorsal condyles present, similar in shape, broadly rounded, median prodorsal condyles close to each other but not fused. Lateral notogastral condyles triangular, with a tiny convex at bottom. One median notogastral condyle, rounded. Ten pairs of notogastral setae. Vitta marginalis distinct. A wavy marginalis, like vitta marginalis, passing the base of adanal setae, ended at level of anterior margin of anal opening.

Description. ***Measurements.*** Body length: 1020 (holotype, male), 990–1360 (paratypes, two males and one female), body width: 540 (holotype, male), 540–650 (paratypes, two males and one female). Setae length and mutual distance (holotype, male): *ro* 120, *le* 140, *bs* 130, *in* 110, *ex* 20; *c*, *la*, *lm*, *lp*, h_1, h_2, h_3, p_1, p_2, p_3 range 80–100; *c*–*c* 370, *la*–*la* 430, *lm*–*lm* 470, *lp*–*lp* 470.

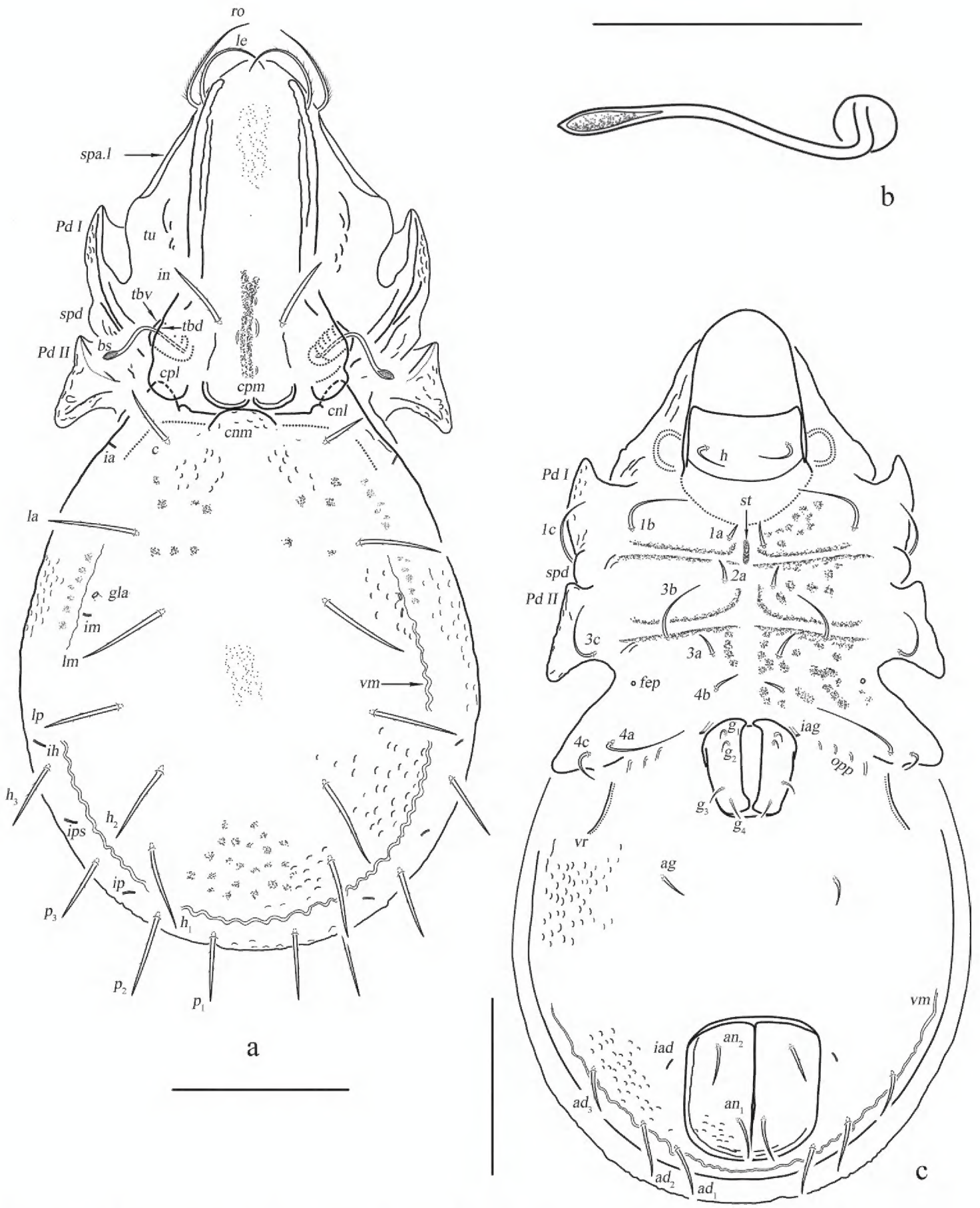

Figure 1. *Basiceramerus ovatus* sp. nov. adult: **a** dorsal view (legs not illustrated) **b** bothridial seta **c** ventral view (legs not illustrated). Abbreviations and notations explained in text. Scale bars: 200 μm (**a, c**); 100 μm (**b**).

Integument. Body color light brownish. Surface of notogaster foveolate.

Prodorsum. Rostrum rounded. Rostral setae moderately curved inward, densely barbed outside. Lamellar setae inserted behind tip of lamella, curved inward, roughened outside. Interlamellar setae barbed and setiform, a pair of longitudinal wrinkles

Figure 2. *Basiceramerus ovatus* sp. nov., adult, microscope images: **a** dorsal view **b** ventral view **c** lateral view. Abbreviations and notations explained in text. Scale bars: 200 μm (**a–c**).

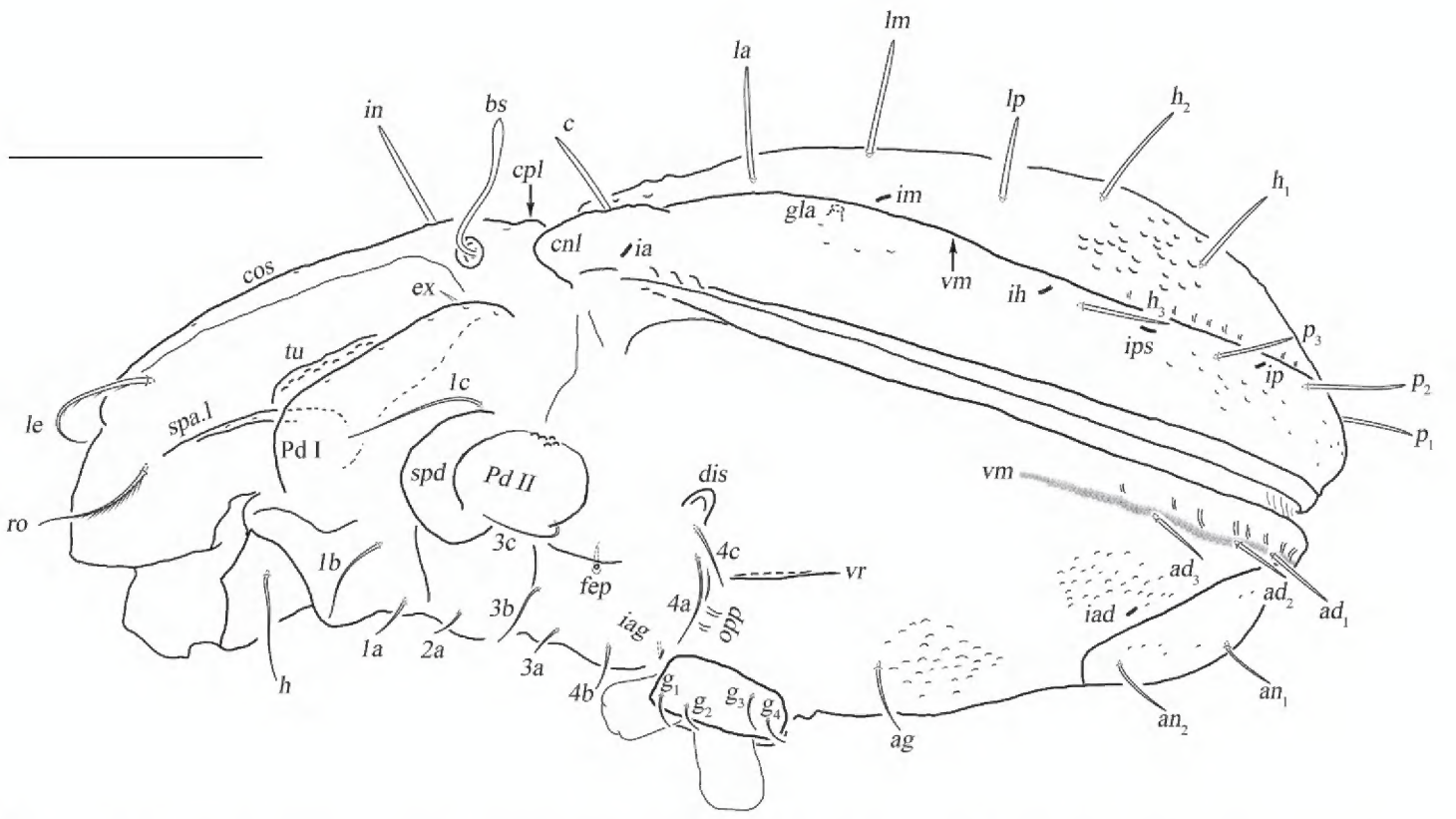

Figure 3. *Basiceramerus ovatus* sp. nov. adult: lateral view (legs not illustrated). Abbreviations and notations explained in text. Scale bar: 200 μm.

extending from its bottom backward to outer margin of median prodorsal condyles. Exobothridial setae short. Bothridial seta with a fusiform head. Tutorium developed, almost touching lamelliform expansion. Lamelliform expansion pointing to bottom of seta *ro*. Bothridium opening laterally, dorsal bothridial plate nearly straight, ventral bothridial plate broadly rounded in dorsal view. Two pairs of prodorsal condyles present, similar in shape, broadly rounded, median prodorsal condyles close to each other but not fused. Mutual distance between ventral bothridial plates nearly equal with that between lateral prodorsal condyles.

Notogaster. L/W of notogaster about 1.3. Lateral notogastral condyles triangular, with a tiny convex at bottom. One median notogastral condyle present, rounded. Ten pairs of notogastral setae, glabrous, setiform, nearly equal in length. Setae *lm* and lyrifissures *im* located nearly same level. All lyrifissures (*im*, *ip*, *ih*, *ips*, except *ia*) well visible in dorsal view, *ip* located between p_2 and p_3, *ips* between h_3 and p_3. Opisthonotal gland openings located anterior and very close to *im*. Vitta marginalis distinct.

Epimeral and lateral podosomal regions. Apodemes II and sejugal apodeme well developed, apodemes III invisible, epimeral foramen present, pedotectum II with anterior and posterior expansions nearly equal in size. Sternal apodeme well visible. Epimeral setal formula 3-1-3-3. Seta *4a* inserted between *4b* and *4c*, and closer to *4c*. Postpodosomal ornamentation well developed.

Anogenital region. Genital plates smooth. Four pairs of genital setae (mutual distances g_1–$g_1 \approx g_2$–$g_2 \approx g_4$–$g_4 < g_3$–g_3). Aggenital lyrifissures located close and anterolateral to genital aperture. One pair of aggenital, two pairs of anal (mutual distances an_1–

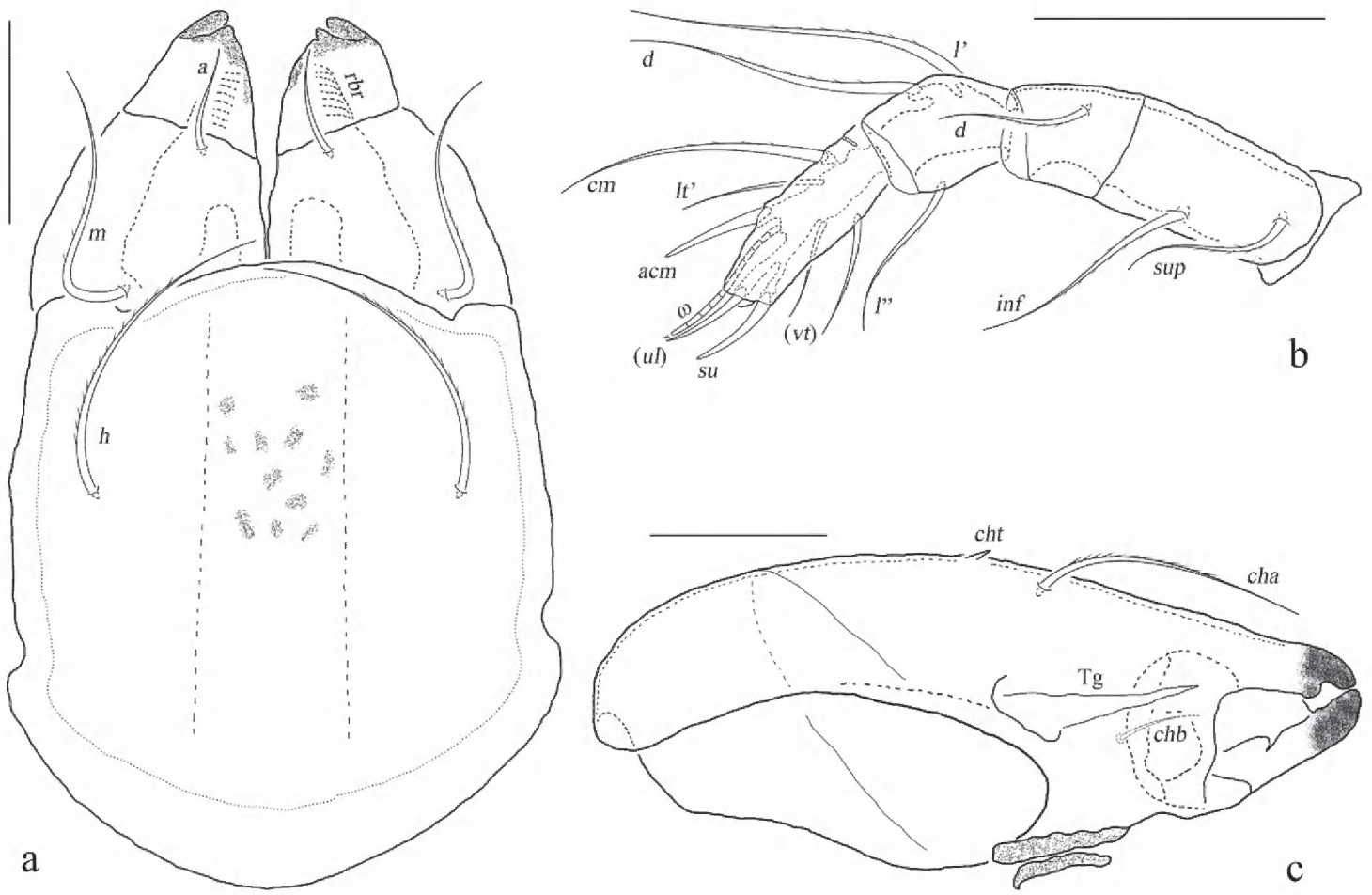

Figure 4. *Basiceramerus ovatus* sp. nov. adult: **a** subcapitulum, ventral view **b** left palp, abaxial view **c** left chelicera, adaxial view. Abbreviations and notations explained in text. Scale bars: 50 μm.

an_1<an_2–an_2, seta an_1 located close to median margin of anal opening) and three pairs of adanal setae similar in length. Setae ad_3–ad_3 well below level of anterior margin of anal opening. Anal plate foveolate. Lyrifissures *iad* located in diagonal position and close to anal aperture, below level of anterior margin of anal opening. A wavy marginalis, like vitta marginalis, passing the base of adanal setae, ending beyond level of anterior margin of anal opening.

Gnathosoma. Subcapitular setae barbed, flagelliform at tips. Rutellum pantelobasic, with typical dentation and rutellar brush. Chelicera chelate-dentate; with a minute denticle proximal to seta *cha*; *cha* longer than *chb*, both of them barbed; Trägårdh's organ narrowly triangular. Palp with usual setal formula: 0-2-1-3-8 (+ω); setae of trochanter to tibia barbed. Tarsus with four short, blunt distal eupathidia–*acm*, *su*, (*ul*); other tarsal setae smooth or with sparse, inconspicuous barbs; base of solenidion ω constrainted by surface of tarsusand thus adjacent to setae *ul'*, *ul"* medioanteriorly. Postpalpal setae erect, smooth.

Legs. Monodactylous. Claw of each leg strong and smooth. Formulae of leg setation and solenidia (Table 1): I (1-4-3-4-16) [1-2-2], II (1-4-3-3-15) [1-1-2], III (2-3-1-2-15) [1-1-0], IV (1-2-2-2-12) [0-1-0]. Leg setae *u* setiform (L-type) on tarsi I, thorn-like (S-type) on tarsi II–IV.

Material examined. ***Holotype*:** male (in alcohol, ZLH-12-225): China, Yunnan Province, Ruili City, Nongdao Town, Nankaiba Village, 23°54'51.19"N, 97°33'58.69"E, 835 m a. s. l., in soil and debris under bush, 23 October 2012.

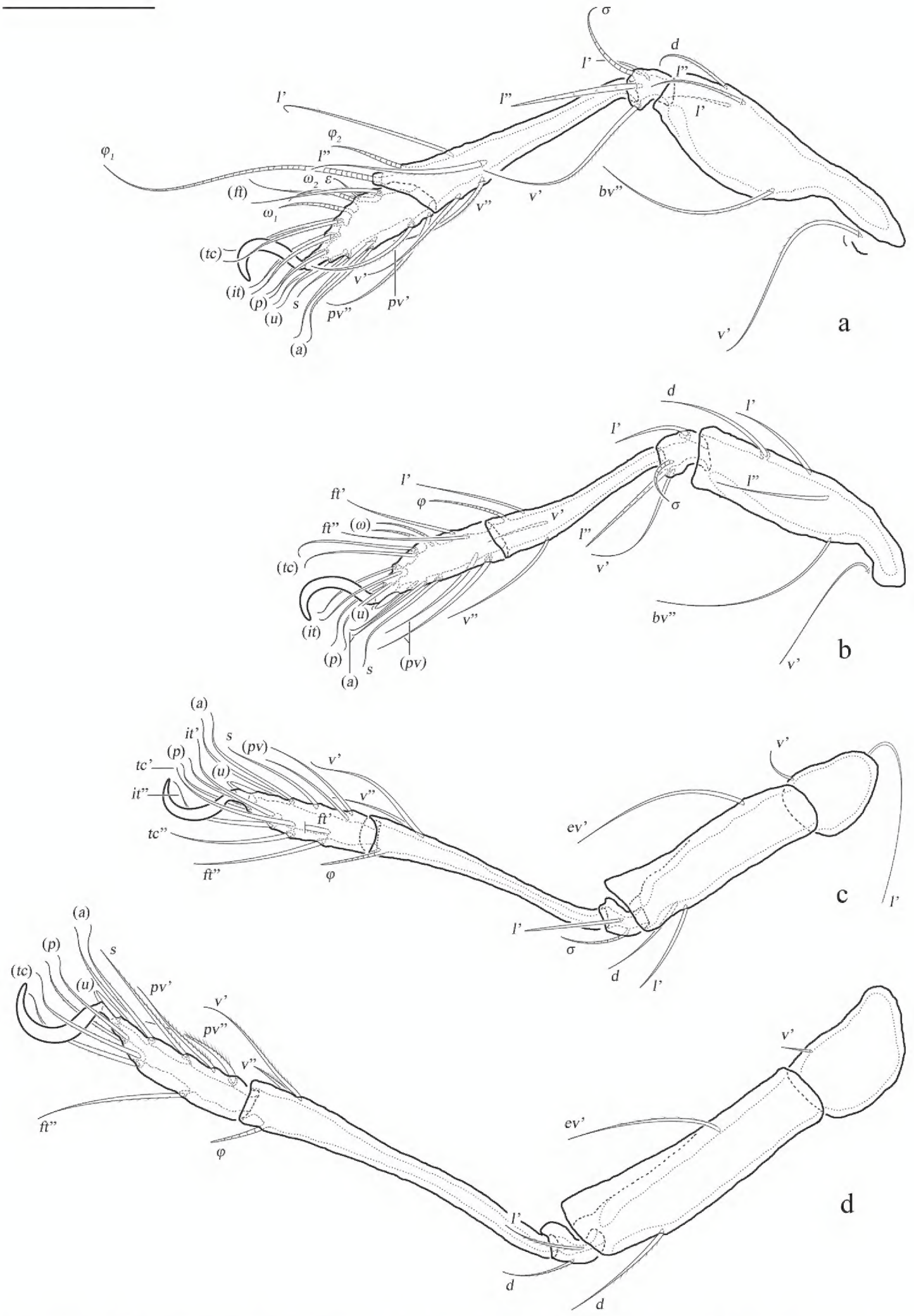

Figure 5. *Basiceramerus ovatus* sp. nov., adult: **a–d** leg I–IV, left, antiaxial view. Abbreviations and notations explained in text. Scale bars: 100 μm (**a–d**).

Table 1. Leg setation and solenidia of adult *Basiceramerus ovatus* sp. nov. Roman letters refer to normal setae, Greek letters to solenidia (except ε=famulus). Single prime (') marks setae on the anterior and double prime (") setae on the posterior side of a given leg segment. Parentheses refer to a pair of setae. Tr – trochanter, Fe – femur, Ge – genu, Ti – Tibia, Ta – tarsus.

Leg	Tr	Fe	Ge	Ti	Ta
I	*v'*	*d*, (*l*), *bv"*	(*l*), *v'*, *σ*	(*l*), (*v*), φ_1, φ_2	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), *ε*, ω_1, ω_2
II	*v'*	*d*, (*l*), *bv"*	(*l*), *v'*, *σ*	*l'*, (*v*), *φ*	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), ω_1, ω_2
III	*l'*, *v'*	*d*, *l'*, e*v'*	*l'*, *σ*	(*v*), *φ*	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*)
IV	*v'*	*d*, e*v'*	*d*, *l'*	(*v*), *φ*	*ft"*, (*tc*), (*p*), (*u*), (*a*), *s*, (*pv*)

***Paratypes*:** two females (in alcohol, ZLH-12-225): same data as holotype; one female (in alcohol, ZLH-12-259): China, Yunnan Province, Yingjiang County, Daonong Village, 24°40'2.568"N, 97°35'54.24"E, 924 m a. s. l., in soil and debris under bush, 31 October 2012. All type specimens were collected by Lihao Zheng.

Type deposition. All type specimens are deposited in the collection of the Institute of Zoology, Chinese Academy of Sciences, Beijing (IZAS).

Etymology. The specific name "*ovatus*" is from Latin for "egg" refers to the oval notogaster in dorsal view.

Remarks. The new species is morphologically similar to *B. bangladeshensis* Corpuz-Raros & Gruèzo, 2008 from Bangladesh and *B. igorotus* Corpuz-Raros & Gruèzo, 2011 from the Philippines and Vietnam (Ermilov and Anichkin 2013) in having two median prodorsal condyles. However, the new species differs from *B. bangladeshensis* by the wavy marginalis, like vitta marginalis, passing the base of adanal setae (vs. none), prodorsal condyles well separated from the median ones (vs. all prodorsal condyles touching at base), ventral ridge present (vs. none), anal plate foveolate (vs. granulate, without foveolae). The species *B. igorotus* was reported from the Philippines and Vietnam by Corpuz-Raros and Gruèzo (2011) and Ermilov and Anichkin (2013) respectively. The latter recorded instances of intraspecific or geographical variability based on their specimens from Vietnam: body size larger and more elongate, interlamellar setae shorter, lamellar setae longer, lateral notogastral condyles narrower, medial notogastral condyles touching base of lateral notogastral condyles, genital plate smooth in the Vietnamese specimens. The new species differs from *B. igorotus* from Vietnam by the wavy marginalis passing the base of adanal setae (vs. none), tutorium and lamelliform expansion nearly touching (vs. well separated), ventral ridge present (vs. none), genital plate smooth (vs. finely striate), seta an_1 located close to the median margin of the anal opening (vs. an_1 well removed from median margin of anal opening); it differs from *B. igorotus* from the Philippines by the lamellar setae inserted behind the tip of the lamella (vs. lamellar setae arising outside the base of cuspis), separated prodorsal condyles (vs. prodorsal condyles all touching at base), *im* posterior to *gla* (vs. *im* anterior to *gla*), genital plate smooth (vs. finely striate), anal plate foveolate (vs. granulate), wavy marginalis, like vitta marginalis, passing the base of adanal setae (vs. none).

***Eurostocepheus* (*Eurostocepheus*) *sinutus* sp. nov.**
http://zoobank.org/2500C6A8-CB6A-44BF-9C05-1B85F9F80471
Figures 6–8

Diagnosis. Body size: 1500 × 850. Body ratio (length/width): 1.8. Body surface relatively smooth. Costula strong, a little "S" shaped curved, largest width of mutual distance anteriorly, curved inward around setae *le*. Pedotecta II disproportionately dilated, with smaller anterior parts and larger posterior parts projecting lateroposteriad. Eight pairs of notogastral setae, *c*, *la*, *lm*, *lp* setiform and slightly barbed distally, p_1, p_2, p_3, h_3 short and ciliform. Epimeral setal formula 3-1-3-3. A pair of ventral grooves between genital aperture and ventral ridge present.

Description. ***Measurements*** (holotype, female). Body length: 1500, body width: 850. Setae length and mutual distance: *ro* 230, *le* 230, *bs* 150, *ex* 20; *c*, *la*, *lm*, *lp* range 210–250; p_1, p_2, p_3, h_3 range 40–60; *c–c* 370, *la–la* 430, *lm–lm* 470, *lp–lp* 470.

Integument. Body color dark brownish. Body surface relatively smooth.

Prodorsum. Rostrum broadly rounded. Rostral setae curved inward, densely barbed outside. Lamellar setae inserted behind tip of costula, curved inward, roughened externally. Interlamellar setae slightly barbed. Bothridial setae with a long fusiform head and a curved peduncle in dorsal view. Exobothridial setae short, hardly visible in dorsal view. Costula strong, weakly "S" shaped, largest width of mutual distance anteriorly, curved inward around setae *le*. Bothridium opening laterally, dorsal bothridial plate nearly straight, ventral bothridial plate invisible in dorsal view. Tutorium developed weakly. Lamelliform expansion curved and pointing to base of seta *ro* in lateral view. Two pairs of prodorsal condyles present, lateral prodorsal condyles broadly flattened and wide, median prodorsal condyles drop-shaped.

Notogaster. L/W of notogaster about 1.1. Surface of notogaster relatively smooth in dorsal view, without visible foveola or granules. Anterior margin of notogaster distinctly moved forward. Lateral notogastral condyles trapezoid, with triangular tip outside, which markedly anterior to medial prodorsal condyles. Median notogastral condyles absent. Eight pairs of notogastral setae, *c*, *la*, *lm*, *lp* longer than others distinctly, setiform and slightly barbed distally, p_1, p_2, p_3, h_3 short and ciliform. All lyrifissures well visible, *ip* located between p_1 and p_2 on left side while it between p_2 and p_3 on right side, *ips* between h_3 and p_3. Opisthonotal gland openings located close to lyrifissure *im*. Vitta marginalis distinct. Lyrifissures *im* and setae *lm* almost located at same level.

Epimeral and lateral podosomal regions. Pedotecta II disproportionately dilated, with smaller anterior parts and larger posterior parts projecting lateroposteriad. Epimeral border I well visible. Apodemes I, II and sejugal apodeme well developed, epimeral foramen present. Sternal apodeme well developed. Epimeral setal formula 3-1-3-3. Epimeral setae slightly barbed, seta *4a* inserted between *4b* and *4c*, and closer to *4c*. Postpodosomal ornamentation present.

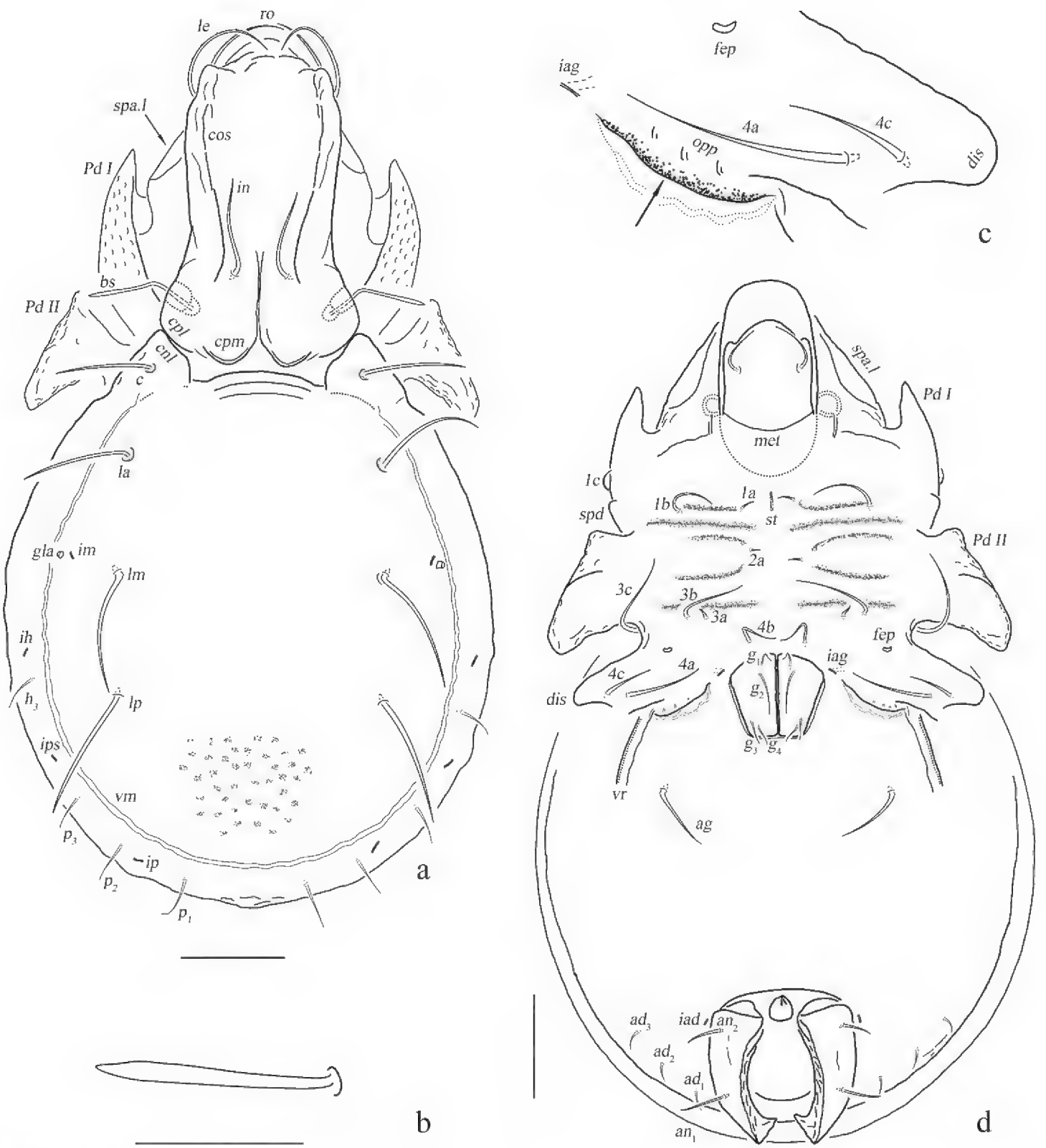

Figure 6. *Eurostocepheus (Eurostocepheus) sinutus* sp. nov., adult: **a** dorsal aspect (legs removed) **b** bothridial seta **c** epimeron IV (left, part), showing ventral groove (arrow) **d** ventral aspect (legs and mouthparts removed). Abbreviations and notations explained in text. Scale bars: 200 μm (**a, d**); 100 μm (**b**).

Anogenital region. Genital plates relatively smooth. Four pairs of genital setae (mutual distances g_1–$g_1 \approx g_2$–$g_2 \approx g_4$–$g_4 < g_3$–g_3, g_2 longer than the rest). Aggenital lyrifissures located close and anterolateral to genital aperture. A pair of ventral groove present between genital aperture and ventral ridge. One pair of aggenital, two pairs of anal (mutual distances an_1–$an_1 < an_2$–an_2) and three pairs of adanal setae short, similar in length. Setae ad_3–ad_3 below level of anterior margin of anal opening. Adanal lyrifissures located in diagonal position and close to anal aperture, below level of anterior margin of anal opening.

Figure 7. *Eurostocepheus (Eurostocepheus) sinutus* sp. nov., adult, microscope images: **a** dorsal view **b** ventral view **c** lateral view. Abbreviations and notations explained in text. Scale bars: 200μm.

Gnathosoma. Subcapitular setae barbed. Rutellum pantelobasic, with typical dentation and rutellar brush. Chelicera chelate-dentate; with a minute denticle proximal to seta *cha*; *cha* longer than *chb*; Trägårdh's organ narrowly triangular. Palp with

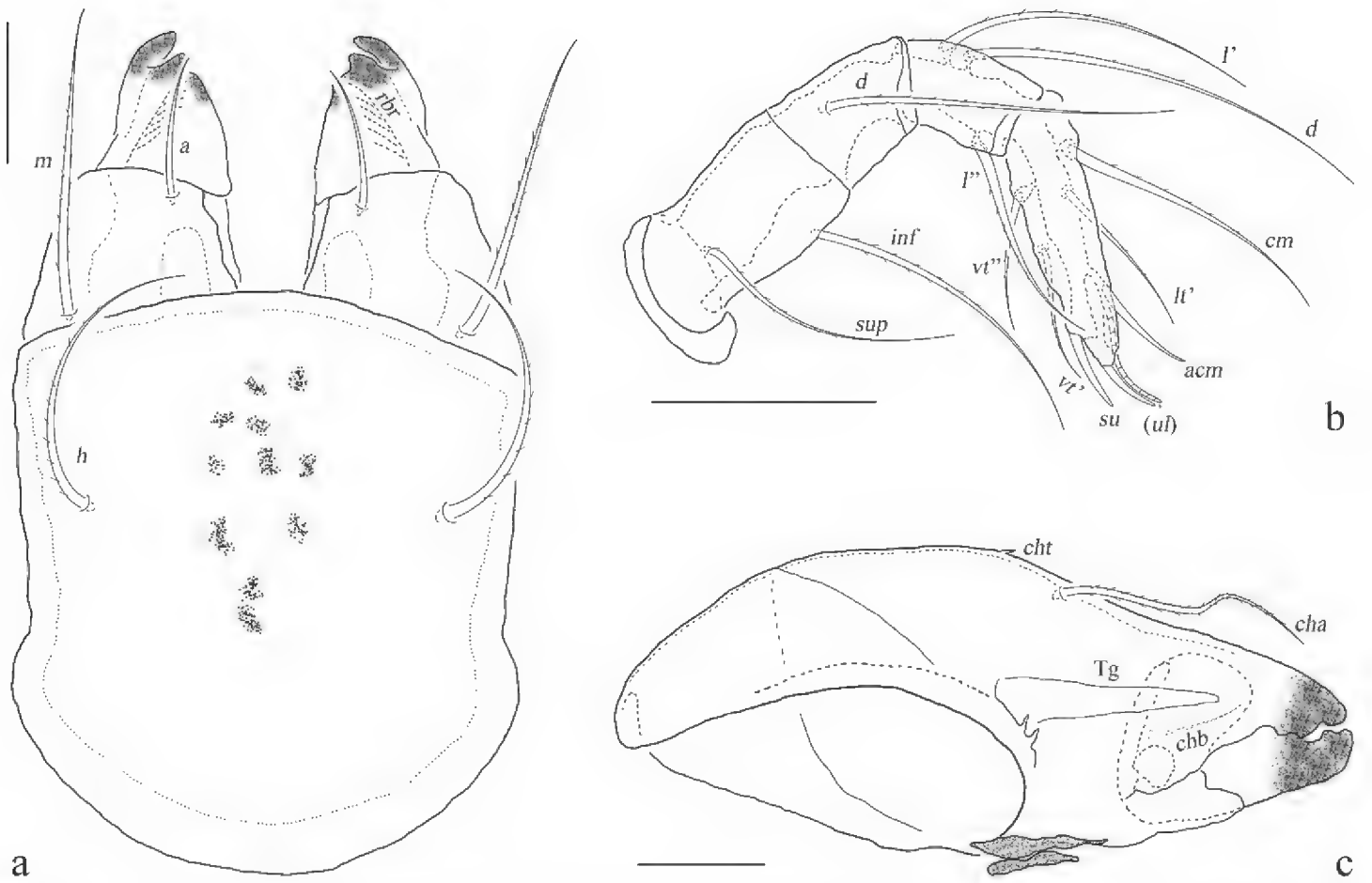

Figure 8. *Eurostocepheus (Eurostocepheus) sinutus* sp. nov., adult: **a** subcapitulum, ventral view **b** right palp, abaxial view **c** left chelicera, adaxial view. Abbreviations and notations explained in text. Scale bars: 50 μm.

usual setal formula: 0-2-1-3-8 (+ω); setae of trochanter to tibia barbed. Tarsus with four short, blunt distal eupathidia–*acm*, *su*, (*ul*); base of solenidion ω constrainted by surface of tarsus, and thus adjacent to setae *ul'*, *ul"* medioanteriorly. Postpalpal setae erect, smooth.

Legs. Monodactylous. Claw of each leg strong and smooth. Formulae of leg setation and solenidia (Table 3): I (1-4-3-4-16) [1-2-2], II (1-4-3-3-15) [1-1-2], III (1-2-1-2-15) [1-1-0], IV (1-2-2-2-12) [0-1-0]. Leg setae *u* setiform (L-type) on tarsi I, thorn-like (S-type) on tarsi II–IV.

Material examined. ***Holotype*:** female (in alcohol, ZLH-12-276): China, Yunnan Province, Yingjiang County, Taiping Town, Huilonghe Reservoir, 24°40'20"N, 97°45'28"E, 1769 m a. s. l., litter and soil under moss, 24 October 2012, collected by Lihao Zheng.

Type deposition. Type specimen is deposited in the collection of the IZAS.

Etymology. The specific name "*sinutus*" is from Latin for "sinus" refers to the ventral groove between genital aperture and ventral ridge.

Remarks. As possessing the conspicuously developed costula and the distinctly dilated posterior pedotecta II, which are diagnostic characters of the genus, this new species should be placed into the genus *Eurostocepheus*. The new species can be easily distinguished from other known species of this genus by its huge body size, eight pairs of notogastral setae and its ventral groove between the genital aperture and the ventral ridge.

Eurostocepheus (*Eurostocepheus*) *aquilinus* Aoki, 1965

New record for China

Figures 9–10

Eurostocepheus aquilinus Aoki, 1965: 334–339, figs 142–146; Ermilov, Niedbała and Anichkin 2012: 23.

Diagnosis. Body size: 1000 × 510. Body ratio (length/width): 2.0. Costula strong, thin anteriorly, and thick posteriorly. Lamelliform expansion sigmoid and passing between base of setae *ro* and *le* in lateral view. Ten pairs of notogastral setae nearly equal in length. Sternal apodeme short and rounded. Epimeral setal formula 3-1-3-2. Epimeral setae slightly barbed, seta *1a*, *2a*, *3a* short and thin, hardly visible.

Description. ***Measurements*** (ZLH-20-029, male). Body length: 1000, body width: 510. Setae length and mutual distance: *ro* 130, *le* 140, *bs* 150, *in* 60, *ex* 20; notogastral setae range 70–110. Mutual distance: *c–c* 140, *la–la* 190, *lm–lm* 210, *lp–lp* 310, h_2–h_2 220, h_1–h_1 210.

Integument. Body color dark brownish. Body surface covered with foveola.

Prodorsum. Rostrum rounded. Both rostral setae and lamellar setae curved inward, slightly barbed outside. Lamellar setae inserted behind tip of costula. Interlamellar setae slightly barbed. Bothridial setae with a long fusiform head and a curved peduncle. Exobothridial setae short, hard to see in dorsal view. Costula strong, thin anteriorly, and thick posteriorly. Bothridium opening laterally, dorsal bothridial plate nearly straight, ventral bothridial plate invisible in dorsal view. Tutorium fainted. Lamelliform expansion sigmoid and passing between bases of setae *ro* and *le* in lateral view. Lateral prodorsal condyles broadly rounded, median prodorsal condyles absent. Mutual distance between ventral bothridial plate nearly equal with that between lateral prodorsal condyles.

Notogaster. L/W of notogaster about 1.3. Lateral notogastral condyles triangular. Median notogastral condyles absent. Ten pairs of notogastral setae nearly equal in length. All lyrifissures well visible, *ip* located between p_2 and p_3, *ips* between h_3 and p_3. Opisthonotal gland openings located close to lyrifissure *im*. Vitta marginalis distinct. Lyrifissures *im* and setae *lm* located nearly same level.

Epimeral and lateral podosomal regions. Epimere I with distinct, long ridge extend to pedotectum I. Apodemes I, II and sejugal apodeme well developed. Sternal apodeme short and rounded. Epimeral setal formula 3-1-3-2. Epimeral setae slightly barbed, seta *1a*, *2a*, *3a* short and thin, hardly visible.

Anogenital region. Genital plates sculptured irregularly with several strong furrows. Four pairs of genital setae (largest mutual distance is g_3–g_3). Aggenital lyrifissures located close and anterolateral to genital aperture. One pair of aggenital, two pairs of anal (mutual distances an_1–an_1<an_2–an_2) and three pairs of adanal setae similar in length. Setae ad_3–ad_3 below level of anterior margin of anal opening. Adanal lyrifissures located longitudinally and close to anal aperture, below level of anterior margin of anal opening.

Gnathosoma. Subcapitular setae barbed. Rutellum pantelobasic, with typical dentation and rutellar brush. Chelicera chelate-dentate; with a minute denticle proximal to

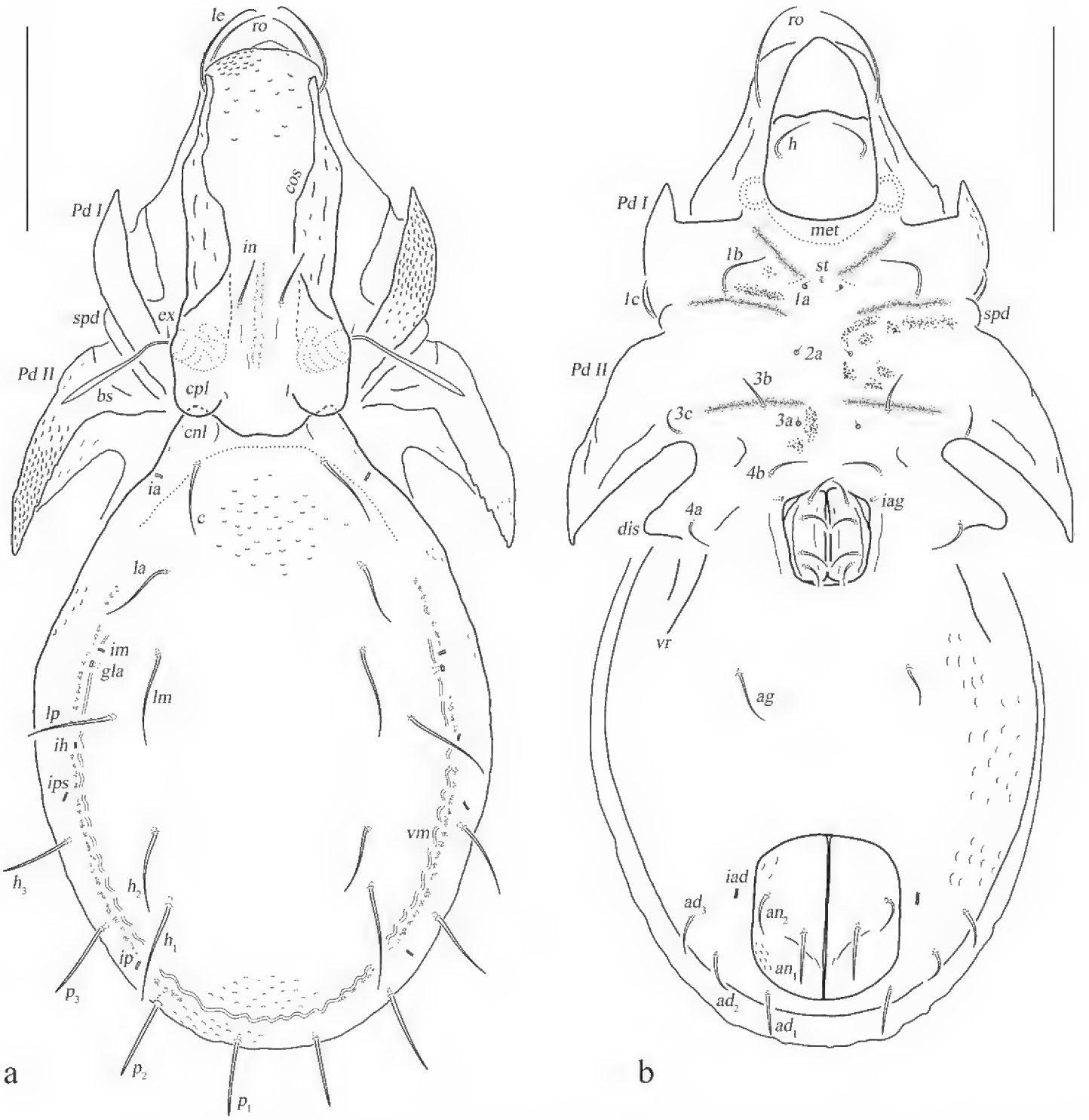

Figure 9. *Eurostocepheus (Eurostocepheus) aquilinus* Aoki, 1965, adult: **a** dorsal aspect (legs removed) **b** ventral aspect (legs and mouthparts removed). Abbreviations and notations explained in text. Scale bars: 200 μm.

seta *cha*; *cha* longer than *chb*; Trägårdh's organ narrowly triangular. Palp with usual setal formula: 0-2-1-3-8 (+ω); setae of trochanter to tibia barbed. Tarsus with four short, blunt distal eupathidia–*acm*, *su*, (*ul*); base solenidion ω constrainted by surface of tarsus, and thus adjacent to setae *ul'*, *ul"* medioanteriorly. Postpalpal setae erect, smooth.

Legs. Monodactylous. Claw of each leg strong and smooth. Formulae of leg setation and solenidia (Table 2): I (1-4-3-4-16) [1-2-2], II (1-4-3-3-15) [1-1-2], III (1-2-1-2-15) [1-1-0], IV (0-2-2-2-12) [0-1-0]. Leg setae *u* setiform (L-type) on tarsi I, thorn-like (S-type) on tarsi II–IV.

Material examined. One male (in alcohol, ZLH-20-029): China, Yunnan Province, Ruili County, Nongdao Town, Nankaiba, 23°55'49"N, 97°32'7"E, 752 m a. s. l., litter and soil under fern, 25 May 2020, collected by Lihao Zheng.

Figure 10. *Eurostocepheus (Eurostocepheus) aquilinus* Aoki, 1965, adult, microscope images: **a** dorsal view **b** ventral view **c** lateral view. Abbreviations and notations explained in text. Scale bars: 200 μm.

Table 2. Leg setation and solenidia of adult *Eurostocepheus (Eurostocepheus) aquilinus* Aoki, 1965.

Leg	Tr	Fe	Ge	Ti	Ta
I	*v'*	*d*, (*l*), *bv"*	(*l*), *v'*, *σ*	(*l*), (*v*), φ_1, φ_2	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), *ε*, ω_1, ω_2
II	*v'*	*d*, (*l*), *bv"*	(*l*), *v'*, *σ*	*l'*, (*v*), *φ*	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), ω_1, ω_2
III	*v'*	*d*, *l'*, ev'	*l'*, *σ*	(*v*), *φ*	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*)
IV	-	*d*, ev'	*d*, *l'*	(*v*), *φ*	*ft"*, (*tc*), (*p*), (*u*), (*a*), *s*, (*pv*)

Specimen deposition. Specimen is deposited in the collection of the IZAS.

Remarks. The specimen checked in this study is almost coincident (shape of lamelliform expansion, different kind of epimeral setae in shape, etc.) with the original description given by Aoki. Here, we provide a supplementary description of this species with new figures and information about morphological characters of this species.

Eurostocepheus (*Eurostocepheus*) *mahunkai* Mondal & Kundu, 1999

New record for China

Figures 11–14

Eurostocepheus (*Eurostocepheus*) *mahunkai* Mondal & Kundu, 1999: 180–186, figs 1–16.

Diagnosis. Body size: 830 × 420. Body ratio (length/width): 2.0. Mutual distance of costula gradually narrow from base to tip. Two pairs of prodorsal condyles present, lateral prodorsal condyles broadly rounded, with bottom straight, median prodorsal condyles rounded, not conspicuous, well separated from each other. Lateral notogastral condyles trapezoid, with triangular tip outside. Epimeral setal formula 3-1-3-3. Genital plates with longitudinal furrows.

Description. ***Measurements*** (holotype, male). Body length: 830, body width: 420. Setae length and mutual distance: *ro* 120, *le* 130, *bs* 100, *in* 160, *ex* 10; notogastral setae range 150–190; *c–c* 170, *la–la* 220, *lm–lm* 180, *lp–lp* 230, h_2–h_2 240, h_1–h_1 130.

Integument. Body color light brownish. Body surface densely foveolate (not well visible on notogaster).

Prodorsum. Rostrum broadly rounded. Rostral setae moderately curved inward, densely barbed outside. Lamellar setae inserted behind tip of costula, curved inward, roughened externally. Interlamellar setae slightly barbed. Bothridial setae with a long fusiform head and a strongly curved peduncle. Exobothridial setae short. Mutual distance of costula gradually narrow from base to tip. Bothridium opening laterally, dorsal bothridial plate nearly straight, ventral bothridial plate triangular in dorsal view. Tutorium fainted. Two pairs of prodorsal condyles present, lateral prodorsal condyles broadly rounded, with bottom straight, median prodorsal condyles rounded, not conspicuous, well separated from each other. Mutual distance between

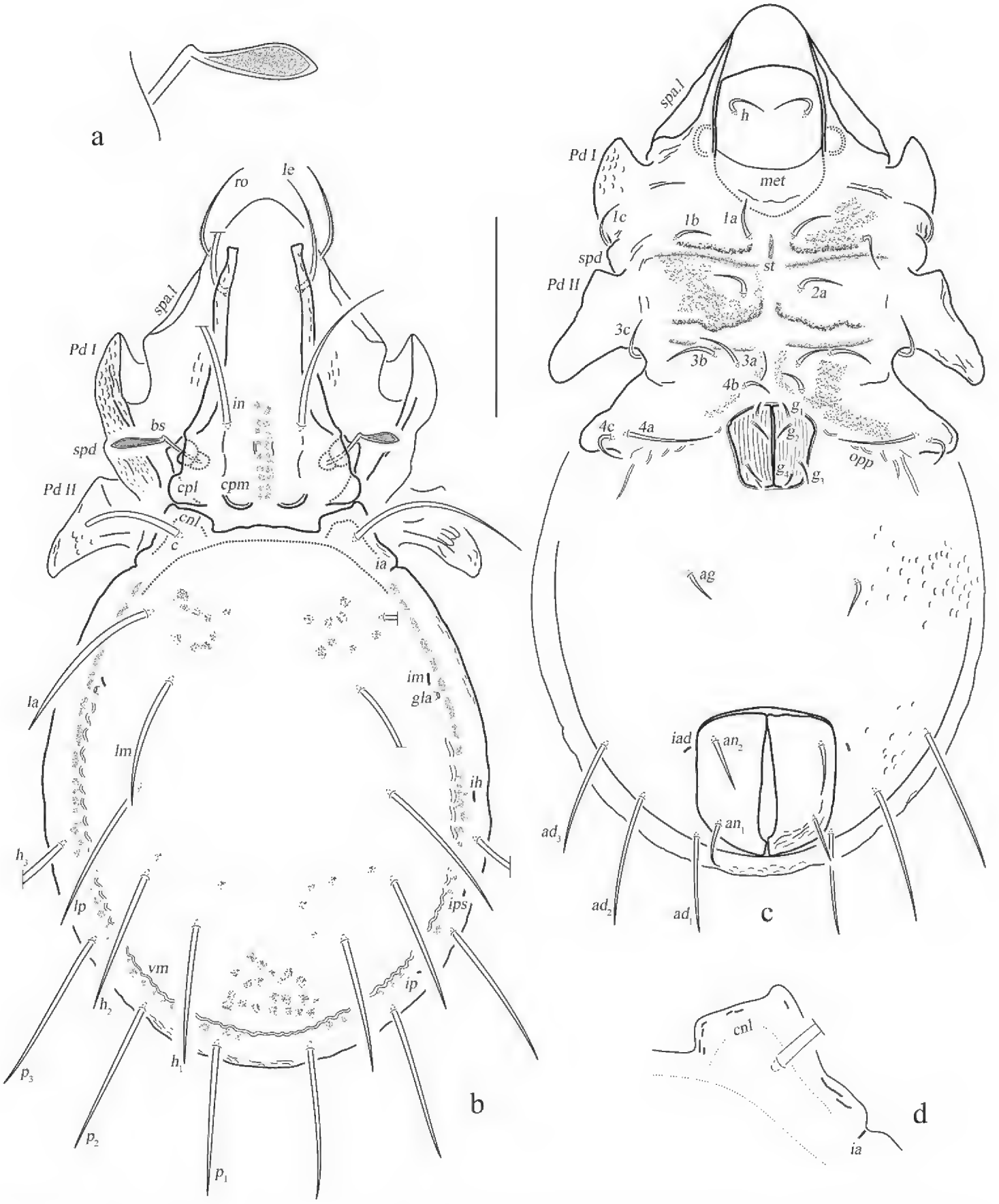

Figure 11. *Eurostocepheus (Eurostocepheus) mahunkai* Mondal & Kundu, 1999, adult: **a** bothridial seta **b** dorsal aspect (legs removed) **c** ventral aspect (legs and mouthparts removed) **d** lateral notogastral condyle (right). Abbreviations and notations explained in text. Scale bars: 200 μm.

ventral bothridial plate nearly equal with that between lateral prodorsal condyles. Subpedotectum well developed.

Notogaster. L/W of notogaster about 1.2. Surface of notogaster relatively smooth in dorsal view. Anterior margin of notogaster slightly curved forward. Lateral notogastral condyles trapezoid, with triangular tip outside. Median notogastral condyles

Figure 12. *Eurostocepheus* (*Eurostocepheus*) *mahunkai* Mondal & Kundu, 1999, adult, microscope images: **a** dorsal view, ventral view **c** lateral view. Abbreviations and notations explained in text. Scale bars: 100 μm.

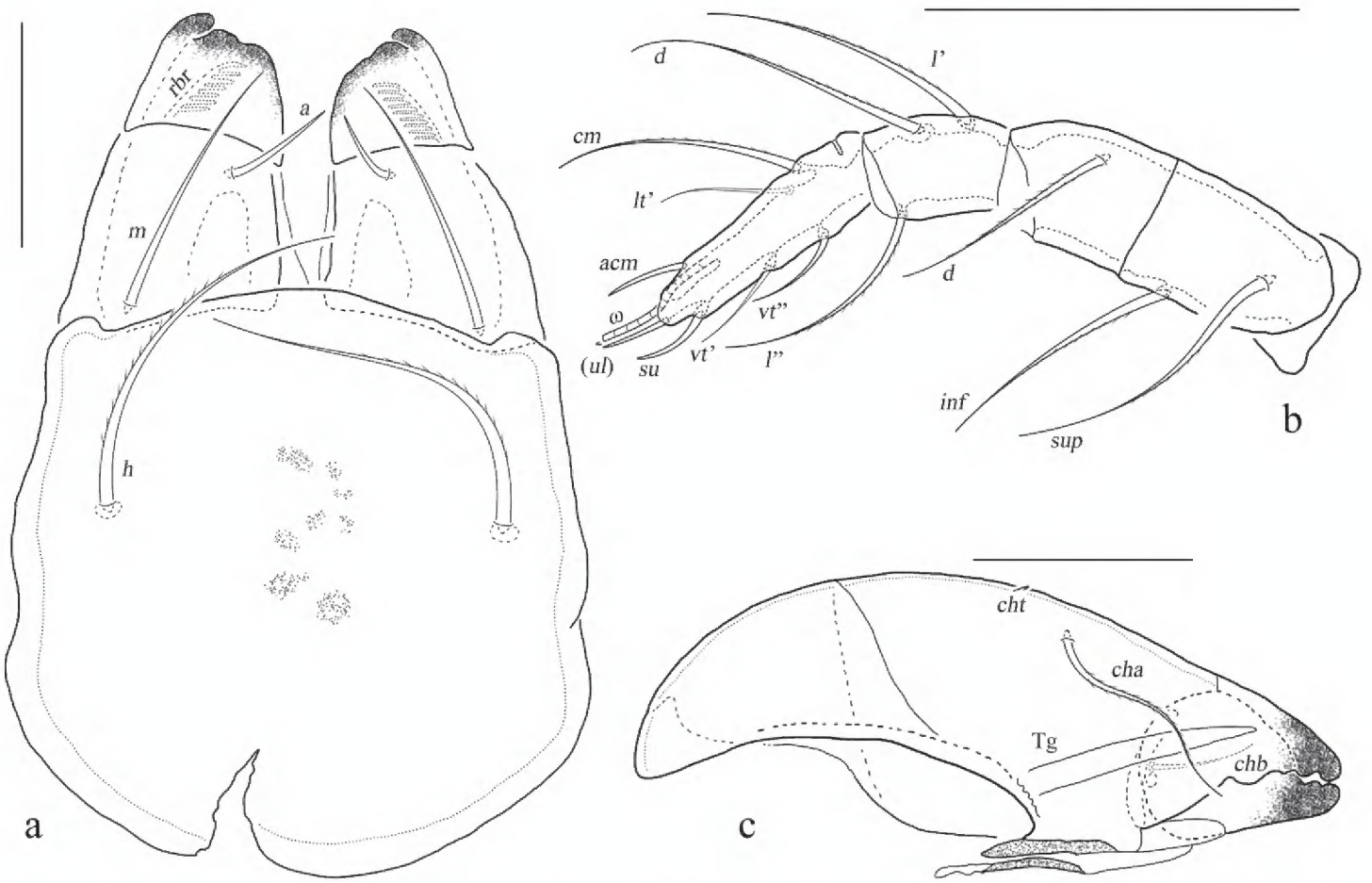

Figure 13. *Eurostocepheus (Eurostocepheus) mahunkai* Mondal & Kundu, 1999, adult: **a** subcapitulum, ventral view **b** left palp, abaxial view **c** left chelicera, adaxial view. Scale bars: 50 μm.

absent. Ten pairs of notogastral setae slightly barbed, setiform. A pair of notchs present in external margin of anterior notogaster, beside lyrifissure *ia*. All lyrifissures well visible, *ip* located between p_2 and p_3, *ips* between h_3 and p_3. Opisthonotal gland openings located posterior and close to lyrifissure *im*. Vitta marginalis distinct. Lyrifissures *im* and setae *lm* located nearly same line.

Epimeral and lateral podosomal regions. Epimere I with distinct, long, transverse ridge. Apodemes I, II and sejugal apodeme well developed, apodeme III short. Sternal apodeme well developed. Epimeral setal formula 3-1-3-3. Seta *4a* inserted between *4b* and *4c*, and closer to *4c*. Postpodosomal ornamentation present.

Anogenital region. Genital plates covered with longitudinal furrows. Four pairs of genital setae (mutual distances g_1–$g_1 \approx g_2$–$g_2 \approx g_4$–$g_4 < g_3$–g_3). Aggenital lyrifissures located close and anterolateral to genital aperture. One pair of aggenital, two pairs of anal (mutual distances an_1–$an_1 \approx an_2$–an_2) and three pairs of adanal setae similar in length. Setae ad_3–ad_3 below level of anterior margin of anal opening. Adanal lyrifissures located in diagonal position and close to anal aperture, below level of anterior margin of anal opening.

Gnathosoma. Subcapitular setae barbed, flagelliform at tips. Rutellum pantelobasic, with typical dentation and rutellar brush. Chelicera chelate-dentate; with a minute denticle proximal to seta *cha*; *cha* longer than *chb*, both of them barbed; Trägårdh's organ narrowly triangular. Palp with usual setal formula: 0-2-1-3-8 (+ω); setae of trochanter to tibia barbed. Tarsus with four short, blunt distal eupathidia–*acm*, *su*, (*ul*); other tarsal setae smooth or with sparse, inconspicuous barbs; base of solenidion ω constrainted by surface of tarsus, and thus adjacent to setae *ul'*, *ul"* medioanteriorly. Postpalpal setae erect, smooth.

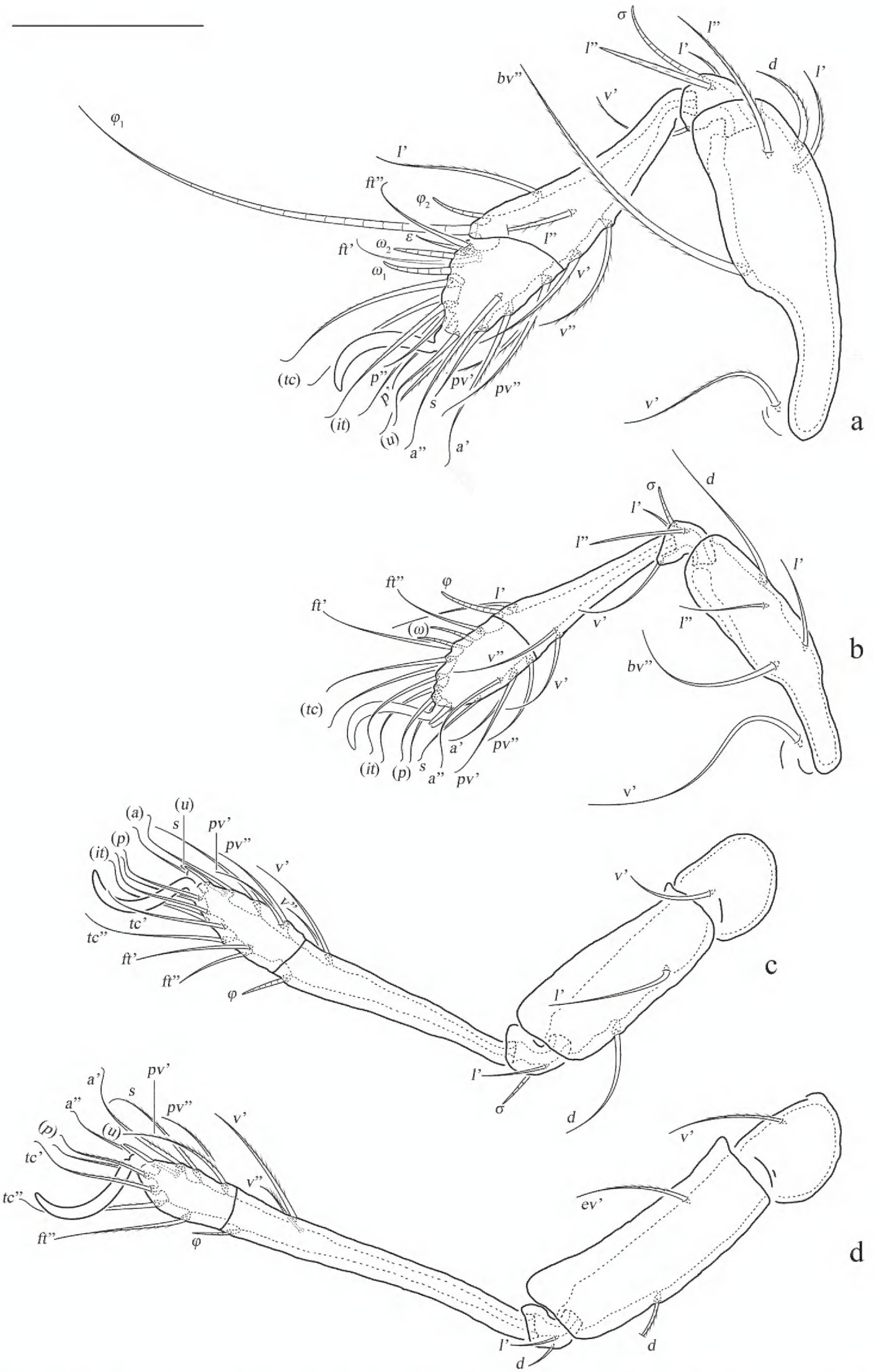

Figure 14. *Eurostocepheus (Eurostocepheus) mahunkai* Mondal & Kundu, 1999, adult: **a** subcapitulum, ventral view **b** left palp, abaxial view **c** left chelicera, adaxial view. Scale bars: 50 μm.

Table 3. Leg setation and solenidia of adult *Eurostocepheus (Eurostocepheus) sinutus* sp. nov. and *Eurostocepheus (Eurostocepheus) mahunkai* Mondal & Kundu, 1999.

Leg	Tr	Fe	Ge	Ti	Ta
I	*v'*	*d*, (*l*), *bv"*	(*l*), *v'*, *σ*	(*l*), (*v*), φ_1, φ_2	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), *ε*, ω_1, ω_2
II	*v'*	*d*, (*l*), *bv"*	(*l*), *v'*, *σ*	*l'*, (*v*), *φ*	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), ω_1, ω_2
III	*v'*	*d*, *l'*, ev'	*l'*, *σ*	(*v*), *φ*	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*)
IV	*v'*	*d*, ev'	*d*, *l'*	(*v*), *φ*	*ft"*, (*tc*), (*p*), (*u*), (*a*), *s*, (*pv*)

Legs. Monodactylous. Claw of each leg strong and smooth. Formulae of leg setation and solenidia (Table 3): I (1-4-3-4-16) [1-2-2], II (1-4-3-3-15) [1-1-2], III (1-2-1-2-15) [1-1-0], IV (1-2-2-2-12) [0-1-0]. Leg setae *u* setiform (L-type) on tarsi I, thorn-like (S-type) on tarsi II–IV.

Material examined. One male (in alcohol, ZLH-12-229): China, Yunnan Province, Ruili City, Nongdao Town, 23°59'49.1"N, 97°39'10.79"E, 1150 m a. s. l., primary forest, litter and soil under bamboo, 24 October 2012, collected by Lihao Zheng.

Specimen deposition. Specimen is deposited in the collection of the IZAS.

Remarks. The specimen collected from Yunnan, Southwest China is morphologically coincident (shape of costula, unsmooth genital plates, epimeral setal formula, etc) with *E.* (*E.*) *mahunkai* described and illustrated by Mondal and Kundu (1999) from Darjeeling, Bengal, India, except for the shape of lateral notogastral condyles (trapezoid in our specimen vs. triangular in Mondal and Kundu's description). Considering that there is intraspecific variation in the shape of notogastral or prodorsal condyles in Otocepheidae (Aoki 1967; Zheng and Chen 2020), we identified this specimen as *E.* (*E.*) *mahunkai*, which has not been recorded in China before.

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